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The Pacific Decadal Oscillation and the Atlantic Multidecadal Oscillation: how much close during the last millennium?

D. Zanchettin (1), J.-H. Jungclaus (1), D. Matei (1), O. Bothe (2,1), and A. Rubino (3)

(1) Max Planck Institute for Meteorology, Ocean in the Earth System Department, Hamburg, Germany, (2) University of Hamburg, KlimaCampus Hamburg, Germany, (3) University of Venice, Dept. of Environm. Sc., Informatics and Statistics, Venice, Italy

We assess the responses of North Atlantic and North Pacific Sea Surface Temperatures (SSTs) to natural forcing and their linkage to simulated global surface temperature (GST) variability in the COSMOS "Community Simulations of the last millennium" ensemble. We focus on the Pacific Decadal Oscillation (PDO) and the Atlantic Muldidecadal Oscillation (AMO) to show that the linkage among low-frequency regional modes of SST variability, and among them and GST, can remarkably vary over the integration time. The PDO-AMO phasing is shown to be inherently variable in time and, generally, rather incoherent among the ensemble members. North Atlantic SSTs show a strong sensitivity to external forcing and a strong connection to GST, while the PDO is rather resilient to natural external perturbations, though being seemingly more sensitive to globally warm conditions. Strong tropical volcanic eruptions and, to a lesser extent, variability in solar activity emerge as potentially relevant sources for multidecadal SST modes phase modulations, possibly through induced changes in the atmospheric teleconnection between North Atlantic and North Pacific that can persist over decadal and multidecadal timescales. Finally, we discuss how multidecadal transitions in simulated North Atlantic SSTs compare to reconstructions and how they contribute characterizing simulated multidecadal regional climate anomalies.